



UM1727 User manual

Getting started with STM32 Nucleo board software development tools

Introduction

The STM32 Nucleo board (NUCLEO-F030R8, NUCLEO-F072RB, NUCLEO-F103RB, NUCLEO-F302R8, NUCLEO-F401RE, NUCLEO-L152RE) is a low-cost and easy-to-use development platform used to guickly evaluate and start a development with an STM32 microcontroller in LQFP64 package.

This document describes the software environment and development recommendations required to build an application around the STM32 Nucleo board. It provides guidelines to beginners on how to build and run a sample application and allows them to create and build their own application. It has the following structure:

- The first chapter presents software and hardware requirements (some toolchains supporting the STM32 families, ST-LINK/V2 installation and firmware package presentation).
- The second chapter provides step by step guideline on how to execute and debug an application example using some toolchains : - IAR Embedded Workbench® for ARM® (EWARM) by IAR systems[®] – Microcontroller Development Kit for ARM[®] (MDK-ARM) by Keil[®] – TrueSTUDIO[®] by Atollic[®].

Although this manual cannot cover all the topics relevant to software development environments, it demonstrates the first basic steps necessary to get started with the compilers/debuggers and offers links to the documents needed to fully understand every single step.



Figure 1. Nucleo development tools

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1 System requirements

Before running your application, you should:

- 1. Install your preferred Integrated Development Environment (IDE).
- 2. Install the ST-LINK\V2 driver from the ST web site. The ST-LINK/V2 driver is installed automatically. In case of problem, you can install manually the driver from toolchains install directory (further details available at *Section 3*).
- 3. Download the STM32 Nucleo firmware from www.st.com/stm32nucleo.
- 4. Establish the connection with the STM32 Nucleo board by connecting CN1 of the Nucleo board to the USB port of the PC.

The above steps will be details in the coming sections.



Figure 2. Hardware environment

To run and develop any firmware application on an STM32 Nucleo board, the minimum requirements are as follows:

- Windows PC (XP, Vista, 7, 8)
- 'USB type A to Mini-B' cable, used to power the board (through USB connector CN1) from host PC and connect to the embedded ST-LINK/V2 for debugging and programming.



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2 IDEs supporting STM32 Families

STMicroelectronics STM32 families of 32-bit ARM[®] Cortex[®]-M core-based microcontrollers are supported by a complete range of software tools. It encompasses traditional integrated development environment IDEs with C/C++ compilers and debuggers from major third-parties (free versions up to 64KB of code, depending on partner), completed with innovative tools from STMicroelectronics.

Table 1 displays general information about Nucleo boards available for the following STM32 devices as well as some integrated development environments.

Order code	Targeted MCU	Toolchains supporting all Nucleos
NUCLEO-F030R8	STM32F030R8T6	EWARM v7.10.3 and later ⁽¹⁾
NUCLEO-F072RB	STM32F072RBT6	- 30-day evaluation edition
NUCLEO-F103RB	STM32F103RBT6	- 32 KB Limited QuickStart edition(16KB Limitation for Cortex M0) MDK-ARM v5.01 and later ⁽¹⁾⁽²⁾
NUCLEO-F302R8	STM32F302R8T6	- MDK-Lite (32KB Code size limitation)
NUCLEO-F401RE	STM32F401RET6	TrueSTUDIO v5 and later ⁽¹⁾
NUCLEO-L152RE	STM32L152RET6	- 32 KB Limitation (8KB for Cortex-M0)

1. Registration before download is required.

2. The device support pack is separate from MDK-ARM releases.



3 ST-LINK/V2 installation

STM32 Nucleo board includes an ST-LINK/V2 embedded debug tool interface. The interface needs an ST-Link/V2 dedicated USB driver to be installed. This driver is available at ST web site at www.st.com ST-LINK/V2 and supported within software toolchains:

• IAR Embedded Workbench[®] for ARM[®] (EWARM)

The toolchain is installed by default in the C:\Program Files\IAR Systems\Embedded Workbench x.x directory on the PC's local hard disk.

After installing EWARM, install the ST-LINK/V2 driver by running the ST-Link_V2_USB.exe from [IAR_INSTALL_DIRECTORY]\Embedded Workbench x.x\arm\drivers\ST-Link \ST-Link_V2_USBdriver.exe

• RealView Microcontroller Development Kit (MDK-ARM) toolchain

The toolchain is installed by default in the C:\Keil directory on the PC's local hard disk; the installer creates a start menu μ Vision4 shortcut.

When connecting the ST-LINK/V2 tool, the PC detects new hardware and requires to install the ST-LINK_V2_USB driver. The "Found New Hardware wizard" appears and guides you through the steps needed to install the driver from the recommended location.

Atollic[®] TrueSTUDIO[®] STM32

The toolchain is installed by default in the C:\Program Files\Atollic directory on the PC's local hard disk.

The ST-Link_V2_USB.exe file is automatically installed when installing the software toolchain.

Complementary information on the firmware package content and the STM32 Nucleo requirements is available on the Getting started with STM32 Firmware.

Note: The embedded ST-LINK/V2 only supports SWD interface for STM32 devices.



4 Firmware package

The STM32 Nucleo firmware applications, demonstration and IP examples are provided in one single package and supplied in one single zip file. The extraction of the zip file generates one folder, STM32 Nucleo_FW_VX.Y.Z, which contains the following subfolders (see *Figure 3*).

Figure 3. Package contents



- **Template project** is a pre-configured project with empty main function to be customized by the user. This is helpful to start creating your own application based on the peripherals drivers.
- **Example project** includes toolchain projects for each peripheral example ready to be run.

4.1 Executing and debugging firmware using software toolchains

4.1.1 EWARM toolchain

The following procedure explains how to compile/link and execute an existing EWARM project.

The steps below can be applied to an already existing example, demonstration or template project available from STM32_Nucleo_FW_VX.Y.Z firmware at www.st.com web site.

First of all, you need to go through the firmware/readme.txt file which contains the firmware description and hardware/software requirements.





Figure 4. IAR Embedded Workbench IDE

- 2. In the **File** menu, select **Open** and click **Workspace** to display the Open Workspace dialog box. Browse to select either an example or demonstration or template workspace file and click **Open** to launch it in the Project window.
- 3. In the **Project** menu, select **Rebuild All** to compile your project.
- 4. If your project is successfully compiled, *Figure 5* is displayed.





Figure 5. EWARM project successfully compiled

If you need to change the project settings (Include and preprocessor defines), go through the following project options:

For Include directories:

Project>Options...>C/C++ compiler>

For pre-processor defines: _

Project>Options...C/C++ compiler>pre-processor>

5. In IAR Embedded Workbench IDE, from the Project menu, select Download and Debug or, alternatively, click the Download and Debug button in the toolbar, to program the Flash memory and start debugging.

Figure 6. Download and Debug button

File Edit View Project Tools Wir	idow Help
D 🛩 🖬 🕼 👃 X 🖻 C	L や や
Workspace ×	Download and Debug

The debugger in IAR Embedded Workbench[®] can be used to debug source code at C 6. and assembly levels, set breakpoints, monitor individual variables and watch events during the code execution.



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orkspace ×	main.c*	• x [Disassembly
0_Toggle Files ↑ 10_Toggle ↓ 10_Toggle ↓ 10	<pre>uint8_t BlinkSpeed = 0; /* Private function prototypes</pre>		Go to Image: Constraint of the system Disassembly 0x8000614: 0xf 0x8000614: 0xf 0x6000618: 0xf ??DataTable1_5: 0x800061c: 0xf ??DataTable1_6: 0x8000620: 0x4 ??DataTable1_7: 0x8000624: 0xf 0x8000624: 0xf 0xf
I0_Toggle Messages Building configuration: IO 7		5	main: 0x8000628:0xt < >
Updating build tree Configuration is up-to-date.			,

Figure 7. IAR Embedded Workbench debugger screen

To run your application from the **Debug** menu, select **Go**. Alternatively, click the **Go** button in the toolbar to run your application.

Figure 8. Go button





4.1.2 MDK-ARM toolchain

1. Open Keil MDK-ARM Microcontroller Kit. *Figure* 9 shows the basic names of the "Keil µvision4" windows referred to in this document.



Figure 9. µvision4 IDE

- 2. In the **Project** menu, select **Open Project...** Browse to select either an example or demonstration or template project file and click **Open** to launch it in the Project window.
- 3. In the **Project** menu, select **Rebuild All target files** to compile your project.
- 4. If your project is successfully compiled, the following window is displayed:

Figure 10. MDK-ARM project successfully compiled



If you need to change your project settings (Include and preprocessor defines), go through the project options:

– For Include directories:

Project>Options for Target > C/C++ > Include Paths

For pre-processor defines:

Project>Options for Target > C/C++ > Preprocessor symbols > Define

5. In MDK-ARM IDE, from the **Debug** menu, select **Start/Stop Debug Session** or, alternatively, click the **Start/Stop Debug Session** button in the toolbar, to program the Flash memory and start debugging.

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6. The debugger in the MDK-ARM can be used to debug source code at C and assembly levels, set breakpoints, monitor individual variables and watch events during the code execution.

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<mark>R2</mark>	0x00000	61:		ocks.HCLK_Freque	ncy / 1000);		
R3 R4	0x08000 0x08000	<					F
R5	0x000000	,,, , _, ,, ,, ,, ,, ,, , ,, , ,, , ,, , ,, , , , , , , , , , , , , , , , , , , ,	up stm32f030.s] main.c				• ×
R6	0x08000	55		he default setti	ng of SystemInit()	function, refer	to d
R7 88	0xFFFFFF	56	system_stm32f0x;				
R9	0xFFFFFF	57	*/				
R10	OxFFFFF	58 59	/* SysTick end of cou	ont event each 1m	a */		
R11	0xFFFFFF	60	RCC GetClocksFreg(&RC		5 "/		
R12 R13 (SP)	0xFFFFF 0x20000	61	SysTick Config(RCC C		ncy / 1000);		_
R13 (3F)	0x08000	62					=
R15 (PC)	0x08000	63	/* Initialize LED2 *,				
	0x61000	64	STM_EVAL_LEDInit(LED)	:);			
Banked		65 66	/* Initialize User Bu	tton on STM32NUC	LEO */		
		67	STM EVAL PBInit (BUTT)				
Mode	Thread	68	`				
Stack	MSP	69	<pre>/* Initiate Blink Spe</pre>	ed variable */			
		70	BlinkSpeed = 0;				
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Load "C:\\STM	32_Nucleo_	FW_V1.0.0\	\Projects\\NUCLEO-F030R	^ Name	Location/Value	Туре	
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•			÷.	-			
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ASSIGN BreakD	isable Bre	akEnable B	reakKill BreakList	Call Stack + Local	Is Memory 1		
					ST-Link Debugger	t1: 0.0000000 sec	L:60 C:1

Figure 12. MDK-ARM debugger screen

To run your application from the **Debug menu**, select **Run**. Alternatively, click the **Run** button in the toolbar to run your application.







4.1.3 TrueSTUDIO toolchain

1. Open Atollic TrueSTUDIO[®] for ARM[®] product. The program launches and requires the Workspace location.

Figure 14.	TrueSTUDIO	workspace	launcher	dialog	box
1 19410 141	1140010010	montopuoo	laanonoi	alaiog	NOA

incerta no	rkspace
	STUDIO® for ARM® stores your projects in a folder called a workspace. orkspace folder to use for this session.
Workspace:	C:\STM32_Nucleo_FW_V1.0.0\Projects\NUCLEO-F030R8\IO_Toggle\TrueSTU V
Use this a	is the default and do not ask again

- 2. Browse to select a TrueSTUDIO workspace of either an example or demonstration or template workspace file and click **OK** to load it.
- 3. To load an existing project in the selected workspace, select **Import** from the **File** menu to display the **Import** dialog box.
- 4. In the **Import** window, open **General**, select **Existing Projects into Workspace** and click **Next**.



Select an import source: type filter text General Archive File Existing Projects into Workspace File System File System C/C++ CVS CVS CVS Example projects C/C++ Source State CVS Source State File System Source State CVS Source State Source State S	Select Create new projects from an archive file or directory.
 General Archive File Existing Projects into Workspace File System Preferences ▷ C/C++ ▷ C/C++ ▷ CVS ▷ Example projects ▷ Git ▷ Install ▷ Run/Debug ▷ SVN ▷ Tasks 	Select an import source:
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	 Archive File Existing Projects into Workspace File System Preferences C/C++ CVS Example projects Git Finstall Finstall Son Install Son SVN Tasks

Figure 15. Atollic TrueSTUDIO[®] import source select dialog box

5. Click **Select** root directory and browse to the TrueSTUDIO workspace folder.



Import	- D X
Import Projects Select a directory to search for existing Eclipse projects.	
Select root directory: C:\STM32_Nucleo_FW_V1.0.0\Projects\NUCLEC Select archive file: Projects:	Browse
IO_Toggle (C:\STM32_Nucleo_FW_V1.0.0\Projects\NUCLEO-F030F	Select All Deselect All Refresh
Copy projects into workspace Working sets Add project to working sets Working sets:	Select
Sack Next > Finish	Cancel

Figure 16. Atollic TrueSTUDIO[®] import projects dialog box

- 6. In the **Projects** panel, select the project and click **Finish**.
- 7. In the **Project Explorer**, select the project, open the **Project** menu, and click **Build Project**.
- 8. If your project is successfully compiled, the following messages will be displayed on the Console window.

Figure 17. TrueSTUDIO[®] project successfully compiled

🔝 Problems 🧟 Tasks 📃 Console 🕴 🔲 Prop	ties) 🕹 🗘 😨 💷 🔂 🗐 🕶 🗂 🕶 🗖
CDT Build Console [IO_Toggle]	
STM32F0xx_StdPeriph_Driver\stm32f0xx_comp -o IO_Toggle.elf -mthumb -mcpu=cortex-m0 -Wl,-cref,-u,Reset_Handler -Wl,-Map=IO_To	u.o STM32F0xx_StdPeriph_Driver\stm32f0xx_dac.o STM32F0xx_StdPeriph_Driver\stm32f0xx_crc.o o STM32F0xx_StdPeriph_Driver\stm32f0xx_ccc.o STM32F0xx_StdPeriph_Driver\stm32f0xx_adc.o T.\STM32F030R8_FLASH.ld -Wl,start-group -lc -lm -Wl,end-group -static gle.map -Wl,gc-sections -Wl,defsymemalloc_getpagesize_P=0x1000 for ARM Pro 4.3.1\ide\jre\bin\java -jar C:\Program Files (x86)\Atollic\TrueSTUDIO for ARM zeinfo IO_Toggle.elf
Print size information	
	lename
2064 32 200 2296 8f8 I	_Toggle.elf
Print size information done	
Generate build reports done	
	*



If you need to change the project settings (Include directories and preprocessor defines), go through Project>Properties and select C/C++ Build>Settings from the left panel:

For Include directories:

C Compiler>Directories>Include path

For pre-processor defines:

C Compiler>Symbols> Defined symbols

9. To debug and run the application, select the project In the **Project Explorer** and press **F11** to start a debug session.

Debug - IO_Toggle/User/main.c - Atollic TrueSTUDIO® for ARM®			
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IO_Toggle.elf [Embedded C/C++ Application]		(t.) 🕫 🖂 🗂 🗗 🍾 🤇
IO_Toggle.elf IO_Toggle.elf Inread [1] < main> (Suspended : Breakpoint)	ie	Value	Descri
■ main() at main.c:51 0x80002f4	🐕 General Registers		Gener
gdb	1919 rO	536870936	
ST-LINK	1010 r1	0	
	•	III	۱.
	4		F
STM32F030R8_FLASH.Id S startup_stm32f030.s	- E	Dutline 🕄	
<pre>48 * @retval None 49 */ 50⊖ int main(void) 51 { 52⊖ /*!< At this stage the microcontroller clock settin 53 this is done through SystemInit() function whi 54 file (startup_stm32f030.s) before to branch to 55 To reconfigure the default setting of SystemIn 56 56 vstem stm32f0xx.c file 4</pre>	ch is called from s application main. hit() function, refe	 Imain.h TimingDelay: volatile uin BlinkSpeed: uint8_t RCC_Clocks: RCC_Clocks main(void): int Delay(volatile uint32_t): v TimingDelay_Decrement(assert_failed(uint8_t*, uint) SWV Console Memory 83 	t32_t TypeDef roid void) : void
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Figure 18. TrueSTUDIO debug window

The debugger in the Atollic TrueSTUDIO can be used to debug source code at C and assembly levels, set breakpoints, monitor individual variables and watch events during the code execution.

To run your application, from the **Run** menu, select **Resume**, or alternatively click the **Resume** button in the toolbar.



4.2 Software toolchain helpful references and web sites

Table 2 gives useful references about the integrated development environments described in this document.

Toolchain	Web sites
EWARM	www.iar.com
MDK-ARM	www.keil.com
TrueSTUDIO	www.atollic.com

Table 2. References and web sites



5 Revision history

Date	Revision	Changes
19-May-2014	1	Initial release



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